Fishery Data Series Number 00-10

Progress Report of Copper River Basin Chinook Salmon Coded Wire Tag Releases, 1997-1999, and Outlook for Adult Recovery

by

David R. Sarafin

July 2000

Alaska Department of Fish and Game **Division of Sport Fish**

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used in Division of Sport Fish Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications without definition. All others must be defined in the text at first mention, as well as in the titles or footnotes of tables and in figures or figure captions.

Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
metric ton	mt
milliliter	ml
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
ounce	oz
pound	lb
quart	qt
yard	yd

Spell out acre and ton.

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
hour (spell out for 24-hour clock)	h
minute	min
second	s

Spell out year, month, and week.

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

All commonly accepted abbreviations.	e.g., Mr., Mrs., a.m., p.m., etc.
All commonly accepted professional titles.	e.g., Dr., Ph.D., R.N., etc.
and	&
at	@
Compass directions:	
east	E
north	N
south	S
west	W
Copyright	©
Corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
et alii (and other people)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.,
id est (that is)	i.e.,
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
number (before a number)	# (e.g., #10)
pounds (after a number)	# (e.g., 10#)
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S. state and District of Columbia abbreviations	use two-letter abbreviations (e.g., AK, DC)

Mathematics, statistics, fisheries

alternate hypothesis	H_A
base of natural logarithm	e
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	F, t, χ^2, etc.
confidence interval	C.I.
correlation coefficient	R (multiple)
correlation coefficient	r (simple)
covariance	cov
degree (angular or temperature)	°
degrees of freedom	df
divided by	÷ or / (in equations)
equals	=
expected value	E
fork length	FL
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
mideye-to-fork	MEF
minute (angular)	'
multiplied by	x
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
standard length	SL
total length	TL
variance	Var

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July 2000

Development and publication of this manuscript were partially financed by the Federal Aid in Sport Fish Restoration Act (16 U.S.C. 777-777K) under Project F-10-15, Job S-3-1(c).

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This document should be cited as:
Sarafin, D. R. 2000. Progress report of Copper River Basin chinook salmon coded wire tag releases, 1997-1999, and outlook for adult recovery. Alaska Department of Fish and Game, Fishery Data Series Number 00-10, Anchorage.

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ABSTRACT

As phase one of a study to test the hypothesis of equal exploitation rates within the Copper River District commercial drift gillnet fishery, coded wire tags were inserted into chinook salmon *Oncorhynchus tshawytscha* juveniles of four Upper Copper River stocks, three stocks per year, during three consecutive seasons, 1997-1999. Juveniles were captured in each system using baited minnow traps, marked with the excision of the adipose fin, inserted with binary coded wire tags using Northwest Marine Technology tag injectors, and released. A total of 47,602 were tagged from the East Fork Chistochina River (1998 and 1999), 71,469 from the Gulkana River (1997, 1998, and 1999), 48,100 from the Klutina River (1997 and 1999), and 47,204 from the Tonsina River (1997 and 1998. For tag recovery, the harvest of the commercial fishery will be screened for marked individuals as the adults return from 2001 through 2004.

Key words: chinook salmon, *Oncorhynchus tshawytscha,* Copper River, Gulkana River, Klutina River, Tonsina River, East Fork Chistochina River, coded wire tag.

INTRODUCTION

Copper River chinook salmon *Oncorhynchus tshawytscha* stocks are harvested in commercial, commercially caught home use, subsistence, personal use (recently designated subsistence), and sport fisheries. Between 1994-1998, an average of approximately 73,600 chinook salmon have been taken annually in these fisheries (Table 1). Comparison of the annual harvests from these fisheries reveals recent, dramatic increases in pressure on these stocks. For sustained management, it is imperative for harvest patterns and spawning escapements to be better understood as more demands are placed upon these stocks by the various fisheries.

Table 1.-Recent 5-year averages of Copper River chinook salmon annual harvests by fishery, 1979-1998.

5-Year Averages	Commercial[a]	Commercial[b] Home Use	Sport[c]	Subsistence/ Personal Use[c]	Total
1979-1983	29,234	[d]	2,229	3,515	34,979
1984-1988	38,717	[d]	2,450	3,009	44,176
1989-1993	31,378	[d]	4,425	4,182	39,985
1994-1998	57,969	1,452	7,613	6,798	73,561

[a] Data from Morstad et al. (1999).

[b] Data from D. Sharp, Alaska Department of Fish and Game, Cordova, personal communication.

[c] Data from Taube (*In press*).

[d] Commercial Home Use was not reported prior to 1994.

These fisheries are managed under current regulations outlined by the Copper River Chinook Salmon Fishery Management Plan. This management plan directs the Alaska Department of Fish and Game (ADF&G) to manage the Copper River commercial and recreational fisheries to achieve a spawning escapement of 28,000 to 55,000 chinook salmon. The best available

information on harvest, age composition, and escapement information obtained from mark-recapture studies, aerial surveys, or other means are to be considered.

Aerial surveys are conducted to provide index counts of chinook salmon in eight clearwater streams in the Upper Copper Basin. These index stream counts reflect the presence or absence of chinook salmon, however, do not reflect accurate escapement to these tributaries. One season of escapement data exists on the Gulkana River, which produces a major portion of the Copper River run, from estimates of fish passage through a weir that was operated in 1996 (LaFlamme 1997).

Radio telemetry studies of Evenson and Wuttig (*In press*) are presently investigating the migration of adult chinook salmon through the Copper River drainage to their natal spawning areas. Scheduled to be conducted for three years, 1999-2001, this study will provide estimates, by year, of the proportions of spawners in each major tributary of the drainage.

The migratory timing of specific Copper River stocks through the commercial fishery is unknown, although presumed to be related to the distance to spawning grounds, as is the case with chinook salmon stocks of other large rivers (Burger et al. 1985, Pahlke and Bernard 1996). In 1999, Evenson and Wuttig (*In press*) did find that the upriver stocks were passing through the Chitina personal use dipnet fishery earlier than the lower river stocks.

The relative exploitation rates of each stock in the commercial fishery are also unknown. As part of a long-term program of stock assessment for chinook salmon in the Copper River, a coded wire tagging (CWT) study was initiated in 1997, consistent with the methods of Cormack and Skalski (1992). The long-term objective of this study is to test the hypothesis that adult chinook salmon from four Copper River stocks with potentially different migratory timing have the same exploitation rate within the commercial fishery.

Stocks of four tributaries, which were believed to be the major components of the Upper Copper River run: the East Fork Chistochina, Gulkana, Klutina, and Tonsina rivers (Figure 1), were selected for study. The objective of the tag deployment phase of this study was to release tagged juveniles in these four systems over a three-year period. Tags were deployed from 1997 to 1999. From a simulation based on a likely scenario, an annual tagging objective of 20,750 juveniles for each cohort tagged was estimated to provide enough tags in recovery to detect meaningful difference in exploitation rates.

The 1999 season was the final year of tag deployment, thus completing phase one of the project. This progress report summarizes the methods and results of the project's tag deployment phase (1997-1999). In addition, a discussion of the outlook for tag recovery is provided. Tag recovery from the commercial fishery is scheduled to begin in 2001 and continue through 2004. Data analysis and findings will be reported following the tag recovery of adult returns.

METHODS

Juvenile chinook salmon were captured using standard, steel mesh minnow traps. The traps were baited with cured salmon roe and placed at various locations near the riverbanks. Traps were typically fished for 20-minute intervals. Beach seines were also used on the Gulkana River; however, were generally found to be less effective.

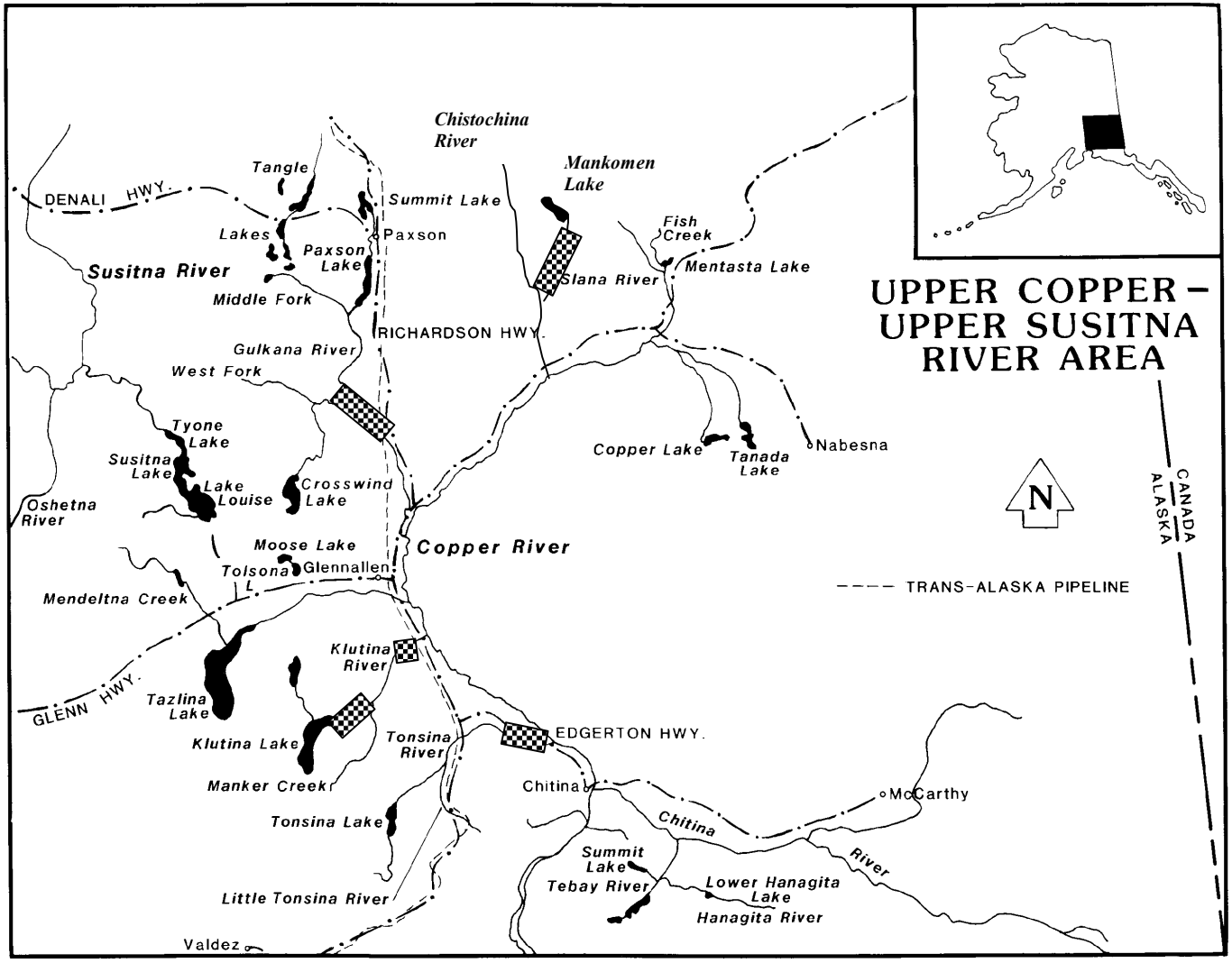

Figure 1.-Upper Copper River Basin chinook salmon coded wire tagging locations (shaded rectangles), 1997-1999.

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Juvenile chinook salmon ≥50 mm fork length (FL) were retained for marking and tag application. All healthy captives were anesthetized in a buffered tricaine methanesulfonate (MS-222) solution to allow handling and reduce associated stress. Prior to marking or tagging, fish were inspected for missing adipose fins. Those with a missing adipose fin were inspected for the presence of a wire tag (procedure follows). Individuals found to have tags were released. Fish were marked with excision of their adipose fin. Binary coded wire tags were then inserted into the snout of each individual with either Northwest Marine Technology[1] (NMT) Mark IV automatic tag injector or a NMT handheld multishot injector. Tagging units were adjusted to either the half-length or full-length setting that inserts a 0.5 or 1.1 mm coded wire tag. Tagging was performed in one session each day.

The presence of the tag was then verified in each fish through the use of a NMT portable sampling detector or a NMT handheld "wand" detector. Fish found to have no tag were again subjected to the insertion procedure and tag presence was again tested.

Tests for short-term tag loss and mortality were performed, unless precluded by logistics or other complications. After the completion of each daily tagging session and prior to release of tagged juveniles, a random sub sampling of 200 individuals was performed for these tests. These fish were retained overnight for a period of 8 to 12 hours. Fish that did not survive the retention were counted and recorded as overnight mortality. The remainder of the retained individuals were then subjected a second time to tag detection procedures for verification of tag presence. All individuals with no tag were recorded as overnight tag loss. When daily tagging sessions produced less than 200 tagged individuals, all individuals of that day's session were retained for the tests.

Upon completion of daily tag insertion and verification, the tagged individuals were then released downstream of the workstation. Data were recorded daily on project log sheets. Estimates of valid tag releases were calculated by multiplying the total number tagged by the overnight tag retention and survival rates.

RESULTS

TAG DEPLOYMENT

Tags were deployed in juvenile chinook salmon of the East Fork Chistochina (upper Copper Basin), Gulkana (middle Copper Basin), Klutina (lower Copper Basin), and Tonsina (lower Copper Basin) rivers through the three year period of 1997-1999. Juveniles of only three of these rivers per year were tagged, resulting in two, three, two, and two representative tagged cohorts, respectively. Throughout these three seasons, tagging was conducted on the East Fork Chistochina River in 1998 and 1999, the Gulkana River in 1997, 1998, and 1999, the Klutina River in 1997 and 1999, and the Tonsina River in 1997 and 1998. The objective for each season was to mark at least 20,750 chinook juveniles from each of the stocks being tagged. This objective was surpassed by roughly 15% in all years for each group tagged (Table 2). Table 3 provides a summary of tag release details, including release dates, tag codes, and results of overnight mortality and tag retention sub sampling.

[1] Product names used in this report are included for scientific completeness, but do not constitute product endorsement.

Table 2.-Estimates of valid tag releases for the Upper Copper River Basin wild chinook salmon coded wire tagging efforts, 1997-1999.

Stock	1997	1998	1999	All Years
E. F. Chistochina	--	23,809	23,795	47,604
Gulkana	23,799	23,733	23,936	71,468
Klutina	23,931	--	24,169	48,100
Tonsina	23,637	23,574	--	47,211
All Stocks	71,367	71,116	71,900	214,383

Juveniles of the East Fork Chistochina River were tagged in 1998 and 1999, yielding release estimates of 23,809 and 23,795, respectively. Three tag codes were used each season. Trapping occurred throughout the length of the river. Tagging crews conducted weekly float trips via whitewater raft with access at Mankomen Lake. Trapping, tagging, and releases occurred at various temporary camp locations. The NMT handheld tag injector and wand detector were utilized for this system.

On the Gulkana River, crews released an estimated 23,799 tagged individuals in 1997, 23,733 in 1998, and 23,936 in 1999. Three tags codes were used during each of the three seasons. A base camp was established downstream of the Sourdough boat launch access point. Trapping occurred from the base camp, upstream to the confluence with the West Fork. The NMT Mark IV tag injector and detector were used.

Tagging was conducted on the Klutina River in 1997 and 1999, yielding release estimates of 23,931 and 24,169, respectively. Three tag codes were applied in 1997 and four codes were applied in 1999. A base camp was established downstream of the Klutina Lake outlet. Trapping occurred primarily within 5 km of the lake outlet; however, roughly 8% of the captures were from near the Richardson Highway Bridge within 3 river km of the confluence with the Copper River. The NMT Mark IV tag injector and detector were used.

Tags were deployed in the Tonsina River in 1997 and 1998, with release estimates of 23,637 and 23,574, respectively. Three tag codes were applied each season. Trapping occurred between 5 and 13 river km upstream of the confluence with the Copper River. The NMT Mark IV tag injector and detector were used.

DISCUSSION

TAG DEPLOYMENT

This project was designed in such a manner as to tag juvenile chinook salmon ≥50 mm FL. Tagging occurred from as early as July 1 and as late as September 3. Life history information on the Copper River chinook salmon stocks is limited, including information regarding size at, and timing of, the smolting stage. The possibility exists that the groups of fish tagged in a given year were composed of not only young-of-the-year fish that would smolt the following year, but also

Table 3.-Upper Copper River Basin wild chinook salmon coded wire tag release summary, 1997-1999.

Release Dates				Estimates from Overnight Retention			Valid
			Number	Number	Expanded	Tag	Tag
Began	Ended	Code	Injected	Retained	Mortality	Retention (%)	Release
			East Fork Chistochina River				
1998							
July-5	Aug-16	312660	8,002	885	74	99.9	7,920
July-16	Jul-26	312661	8,081	1,508	38	99.4	7,995
Aug-2	Aug-10	312662	7,972	1,016	78	100.0	7,894
Total							**23,809**
1999							
Jul-2	Jul-20	310122	8,401	1,998	54	99.9	8,339
July-23	Aug-1	310123	8,947	947	92	100.0	8,855
Aug-6	Aug-16	310124	6,606	568	5	100.0	6,601
Total							**23,795**
			Gulkana River				
1997							
July-4	Aug-13	312657	8,942	2,403	196	99.7	8,720
July-17	Jul-24	312658	7,692	1,458	18	99.9	7,666
Aug-1	Aug-9	312659	7,611	1,479	93	98.6	7,413
Total							**23,799**
1998							
Jul-23	Aug-1	312704*2	7,275	1,200	17	96.8	7,026
Aug-3	Aug-14	312705	9,801	1,800	26	95.4	9,325
Aug-18	Aug-29	310125	7,457	1,800	0	99.0	7,382
Total							**23,733**
1999							
Jul-1	Sept-3	310116	10,014	2,655	6	99.9	9,998
Aug-3	Aug-31	310117	10,836	3,000	11	99.9	10,814
Aug-19	Aug-24	310118	3,124	0	0	100.0	3,124
Total							**23,936**
			Klutina River				
1997							
July-2	Aug-26	1301031002	6,671	1,660	104	100.0	6,567
July-15	Jul-26	1301031003	8,680	1,552	154	100.0	8,526
July 29	Aug-8	1301031004	9,010	1,510	172	100.0	8,838
Total							**23,931**
1999							
Jul-1	July-14	310119	6,257	1,593	129	99.9	6,122
July-14	July-29	310120	6,898	1,230	107	99.6	6,764
Aug-3	Aug-17	310121	10,170	1,626	68	99.6	10,062
Aug-17	Aug-18	310126	1,245	206	18	99.5	1,221
Total							**24,169**
			Tonsina River				
1997							
July-11	Aug-21	312663	6,933	2,943	39	96.2	6,839
July-28	Aug-8	312701	5,186	2,174	20	96.2	4,970
Aug-11	Aug-21	312702	12,135	2,047	53	97.9	11,828
Total							**23,637**
1998							
Jul-9	July-17	1301031005	5,146	1,318	105	99.2	5,001
July-21	July-31	1301031006	10,834	1,425	43	99.6	10,748
Aug-5	Aug-13	1301031007	7,927	1,000	47	99.3	7,825
Total							**23,574**

fish that would smolt in the year tagged. The operational plan does not address this factor; however, this possibility should be considered in the analysis of tag returns.

The only complication throughout the tag release phase occurred during the 1998 season. At the start of this season, on the Gulkana River, two initial sets of tags were deployed at an incorrect cut length setting. Specifically, 1.1 mm length tags were cut at half-length on insertion. A total of 5,953 tags with the code of 312703 and 2,600 tags with the code of 312704 were applied in this manner. These releases were not included in estimates of valid tag releases. The setting on the machine was corrected, the use of code 312704 was continued, and an additional 7,275 tags of this code were applied at the proper setting (valid release estimate of 7,024). Any recovery of tags of this code will need to be verified as being 1.1 mm in length, as opposed to 0.5 mm. Any data from mis-cut tags will not be considered in the analysis for this project. The tag lab is aware of this condition and confirmed their ability to distinguish these mis-cuts. In the database, the mis-cuts are recorded as 312704*1 and the correct cuts are recorded as 312704*2.

TAG RECOVERY

The next phase of operations will be the inspection of the commercial fishery for marks (missing adipose fins), scheduled to begin in 2001. With the limited life history information available on Copper River chinook salmon stocks, age-class compositions of juveniles in the systems that were tagged are unknown. However, as a precursor to predicting the years of return for the tagged individuals, recent five-year averages of the estimated age-class composition of chinook salmon harvested in the Copper River District commercial fishery were calculated (Table 4).

Table 4.-Estimated age-class composition of chinook salmon harvested in the Copper River District commercial fishery, 5-year average[a], 1994-1998.

Age-Class								
0.2	1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4
0.1%	0.2%	6.7%	52.1%	0.2%	39.2%	0.6%	0.3%	0.4%

[a] Data from Donaldson et al. (1995) and Morstad et al. (1996-1999).

To provide estimates of when to expect the return of released tags, the average age-class compositions were assumed to be similar for juveniles and harvested adults, combined by age of brood, and applied to the number of tag releases for each stock and year of tagging. (For the purpose of these estimates, it was assumed that all fish tagged in a given year were young-of-the-year.) Table 5 provides these estimates of anticipated return years, shown in percentages of the tag releases, by stock. From these estimates, screening of the commercial harvest and tag recovery is planned to begin in 2001, continuing through 2004. This period should cover the prime years of recovery for all releases, in addition to the releases of each stock tagged.

Table 5.-Estimated years of return[a] of tag releases, shown in percentages of the total releases for each stock tagged, for the Upper Copper River Basin wild chinook salmon coded wire tagging project.

	Stock Tagged				
Return Year	E.F.Chistochina	Gulkana	Klutina	Tonsina	All Stocks
2000	0.0%	2.3%	3.3%	3.5%	2.3%
2001	3.5%	20.1%	26.7%	30.1%	20.1%
2002	30.1%	32.9%	22.6%	46.0%	32.9%
2003	46.0%	31.0%	27.2%	19.7%	31.0%
2004	19.7%	13.2%	19.4%	0.4%	13.2%
2005	0.4%	0.3%	0.4%	0.0%	0.3%
	100.0%	100.0%	100.0%	100.0%	100.0%

[a] Calculations based on 5 year average of age composition estimates of chinook salmon harvested in the Copper River District commercial fishery, 1994-1998.

Much of the chinook salmon harvest of the Copper River District fishery is delivered to tenders near the point of harvest. The tenders then transport catch to processors located in either Cordova or Valdez. In addition, catcher vessels deliver directly to the Cordova processors. All of the catch is processed in either Cordova or Valdez; offshore processing is not involved. The majority of the catch is processed in Cordova. The majority of the chinook harvest typically occurs from mid-May through mid-June and then drops off through the end of June.

Technicians will screen the chinook salmon harvest upon delivery to the processing plants in Cordova and Valdez. Screening objectives are at least 20% of the catch during weeks 1-4 of the fishery, and 50% during weeks 5-6 when the catch is typically much lower. All heads of individuals found to be missing the adipose fin will be removed and shipped to the ADF&G CWT Lab in Juneau for tag dissection and code identification. Data from this process will then be analyzed with results presented in a final project report.

ACKNOWLEDGEMENTS

Todd LaFlamme was the project biologist during the 1997 and 1998 seasons. David Bernard assisted with the project design. Ron Burr, Mark DeWitt, J.D.Hatley, Austin Mahalkey, Larry Gondek, Bruce Gordon, Tim Ross, Mark Schlenker, Mark Stadtmiller, Tim Stadtmiller, Duncan Tipton, and Doug Vollman performed the fieldwork and data collection. Tom Taube and Peggy Merritt provided project guidance. Matt Evenson provided editorial review of this report. Sara Case prepared the final report. Al Near allowed use of the Mankomen Lake Lodge airstrip for access of the East Fork Chistochina River. Al Taylor allowed access to the Tonsina River.

LITERATURE CITED

Burger, C. V., R. L.Wilmot, and D. B. Wangaard. 1985. Comparison of spawning areas and times for two runs of chinook salmon *Oncorhynchus tshawytscha* in the Kenai River, Alaska. Can. J. Fish. Aquat. Sci. 42:693-700.

Cormack, R. M. and Skalski, J. R. 1992. Analysis of coded wire tag returns from commercial catches. Can. J. Fish. Aquat. Sci. 49:1816-1825.

Donaldson, W., S. Morstad, D. Sharp, J. Wilcock, and S. Sharr. 1995. Prince William Sound management area 1994 annual finfish management report. Alaska Department of Fish and Game, Regional Information Report No. 2A95-47, Anchorage.

Evenson, M. J. and K. G. Wuttig. *In press.* Inriver abundance, spawning distribution, and migratory timing of Copper River chinook salmon *Oncorhynchus tshawytscha* in 1999. Alaska Department of Fish and Game, Fishery Data Series, Anchorage.

LaFlamme, T.R. 1997. Creel and escapement estimates for chinook salmon on the Gulkana River, 1996. Alaska Department of Fish and Game, Fishery Data Series No. 97-12, Anchorage.

Morstad, S., D. Sharp, J. Wilcock, and J. Johnson. 1996. Prince William Sound management area 1995 annual finfish management report. Alaska Department of Fish and Game, Regional Information Report No. 2A96-25, Anchorage.

Morstad, S., D. Sharp, J. Wilcock, and J. Johnson. 1997. Prince William Sound management area 1996 annual finfish management report. Alaska Department of Fish and Game, Regional Information Report No. 2A97-17, Anchorage.

Morstad, S., D. Sharp, J. Wilcock, T. Joyce, and J. Johnson. 1998. Prince William Sound management area 1997 annual finfish management report. Alaska Department of Fish and Game, Regional Information Report No. 2A98-05, Anchorage.

Morstad, S., D. Sharp, J. Wilcock, T. Joyce, and J. Johnson. 1999. Prince William Sound management area 1998 annual finfish management report. Alaska Department of Fish and Game, Regional Information Report No. 2A99-20, Anchorage.

Pahlke, K. A. and D. R. Bernard. 1996. Abundance of the chinook salmon escapement in the Taku River, 1989 to 1990. Alaska Fishery Research Bulletin 3:9-20.

Taube, T. T. *In press*. Area management report for the recreational fisheries of the Upper Copper/Upper Susitna River management area, 1998. Alaska Department of Fish and Game, Fishery Management Series, Anchorage.